

REPORT DOCUMENTATION PAGE**Form Approved**
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Washington Headquarters Service, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington, DC 20503.

PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.**1. REPORT DATE (DD-MM-YYYY)**

03-09-2004

2. REPORT TYPE

Final Report

3. DATES COVERED (From - To)

09-03-2003 - 28-01-2004

4. TITLE AND SUBTITLENON-THERMAL PLASMA DECONTAMINATION TECHNOLOGY FOR
FORWARD-DEPLOYED FORCES.**5a. CONTRACT NUMBER**

N00014-03-M-0154

5b. GRANT NUMBER

N00014-03-M-0154

5c. PROGRAM ELEMENT NUMBER**5d. PROJECT NUMBER****5e. TASK NUMBER****5f. WORK UNIT NUMBER****6. AUTHOR(S)**

Golkowski Czeslaw

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)Super Pulse
227 Durfee Hill Rd.
Ithaca, NY 14850**8. PERFORMING ORGANIZATION
REPORT NUMBER****9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)**Office Of Naval Research
800 N. Quincy St.
Arlington, VA 22217-5000**10. SPONSOR/MONITOR'S ACRONYM(S)**
ONR**11. SPONSORING/MONITORING
AGENCY REPORT NUMBER****12. DISTRIBUTION AVAILABILITY STATEMENT**
Distribution UnlimitedApproved for Public Release
Distribution Unlimited

20040914 019

13. SUPPLEMENTARY NOTES**14. ABSTRACT**

Non-thermal plasma processing is an emerging advanced oxidation technology for oxidation of hazardous microorganisms and compounds at low temperature. The plasma generated during an electrical discharge or when an energetic particle beam is injected into air produces copious free radicals. These free radicals are utilized in the chemical reactions, which normally would require very high temperature. Neutralization of chemical and biological warfare simulant agents deposited on surfaces was tested using non-thermal plasma source developed by Super Pulse. The surfaces tested varied from plastics to metal. The results show that the non-thermal plasma produced by the developed source is a very effective oxidizer.

15. SUBJECT TERMS

Free radicals, Non-thermal plasma, decontamination, electric discharge.

16. SECURITY CLASSIFICATION OF:**a. REPORT**
unclassified**b. ABSTRACT**
unclassified**c. THIS PAGE**
unclassified**17. LIMITATION OF
ABSTRACT**
UL**18. NUMBER
OF PAGES**
1**19a. NAME OF RESPONSIBLE PERSON**
Dr. Czeslaw Golkowski**19b. TELEPHONE NUMBER (Include area code)**
607 272 1251

FINAL REPORT

Grant #: N00014-03-M-0154

PRINCIPAL INVESTIGATOR: Dr. Czeslaw Golkowski

INSTITUTION: SUPER PULSE

**GRANT TITLE: NON-THERMAL PLASMA DECONTAMINATION
TECHNOLOGY FOR FORWARD-DEPLOYED FORCES.**

AWARD PERIOD: 9 March 2003 – 28 January 2004

OBJECTIVE: The main technical objective of Phase I was a proof-of-principle demonstration that a non-thermal plasma source developed by Super Pulse is suitable for development of a decontamination device for forward-deployed forces to fight-through and recover from a terrorist or other asymmetric attack.

APPROACH: Non-thermal plasma processing is an emerging advanced oxidation technology for oxidation of hazardous microorganisms and compounds at low temperature. The plasma generated during an electrical discharge or when an energetic particle beam is injected into air produces copious free radicals. These free radicals are utilized in chemical reactions, which normally would require very high temperatures. Neutralization of chemical and biological warfare simulant agents deposited on surfaces was tested using non-thermal plasma. The surfaces tested varied from plastics to metal.

ACCOMPLISHMENTS: Non-thermal plasma production was stable and reliable. The plasma killed (up to 100%) microorganisms (vegetative *Escherichia coli* and spores *Bacillus subtilis*) deposited on surfaces in time of seconds. A chemical simulant agent deposited on a surface was decomposed.

CONCLUSIONS: The results show that the non-thermal plasma produced by the developed Super Pulse source is a very effective oxidizer. The results also showed that this plasma is very effective in killing microorganisms (spores and vegetative) deposited on different surfaces. The effectiveness of chemical warfare agent neutralization also has been shown.

SIGNIFICANCE: Non-thermal plasma can be used in decontamination of surfaces where other decontamination methods are not feasible.

PATENT INFORMATION: NONE

AWARD INFORMATION: NONE

PUBLICATIONS AND ABSTRACTS: NONE

DISTRIBUTION STATEMENT A
Approved for Public Release
Distribution Unlimited